
Physical Science EOCT Review
Domain 4: Physics- Waves Electricity and Magnetism


Domain 3: Physics- Waves

Waves & Sound

A. Waves

1. The nature of waves

a. A wave is a rhythmic disturbance that transfers energy.

b. All waves are made by something that vibrates.

2. Mechanical waves need a matter medium to travel through.

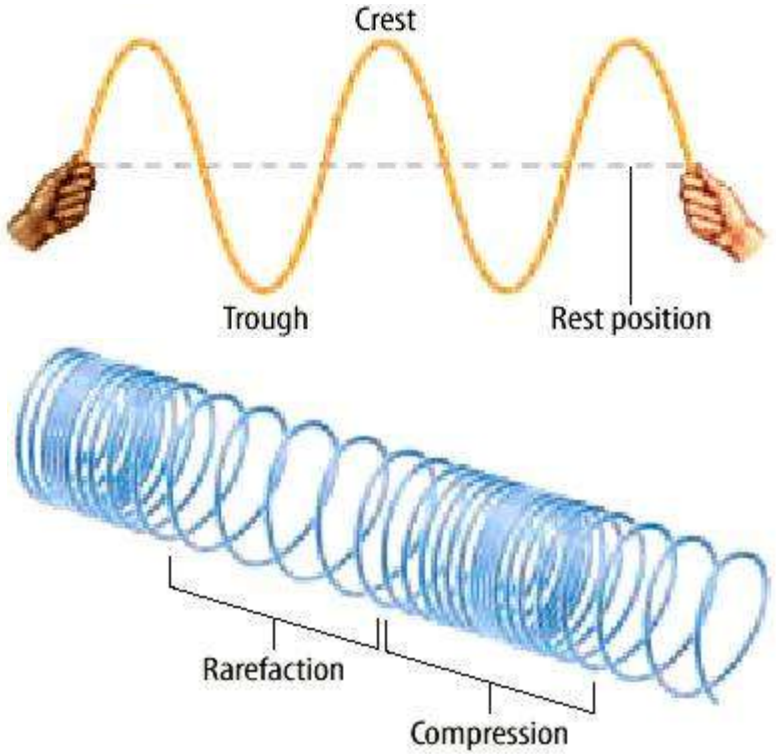
(sound, water, seismic)

3. Two basic types of waves:

   a. Transverse

   b. Compressional

      (longitudinal)



4. Wave properties:

a. Wavelength - distance from a point on a wave to the same corresponding point on the next wave.

b. Frequency - number of waves that pass a point in one second (expressed in Hz).

c. Wavelength has an inverse relationship to wave frequency.

d. Wave velocity depends on the type of wave and medium.

1) Sound is faster in more dense media and in higher temps.

2) Light is slower in more dense media, but faster in a vacuum.

3) $v = \lambda \times f$

e. Amplitude - size related to the energy carried by the wave.

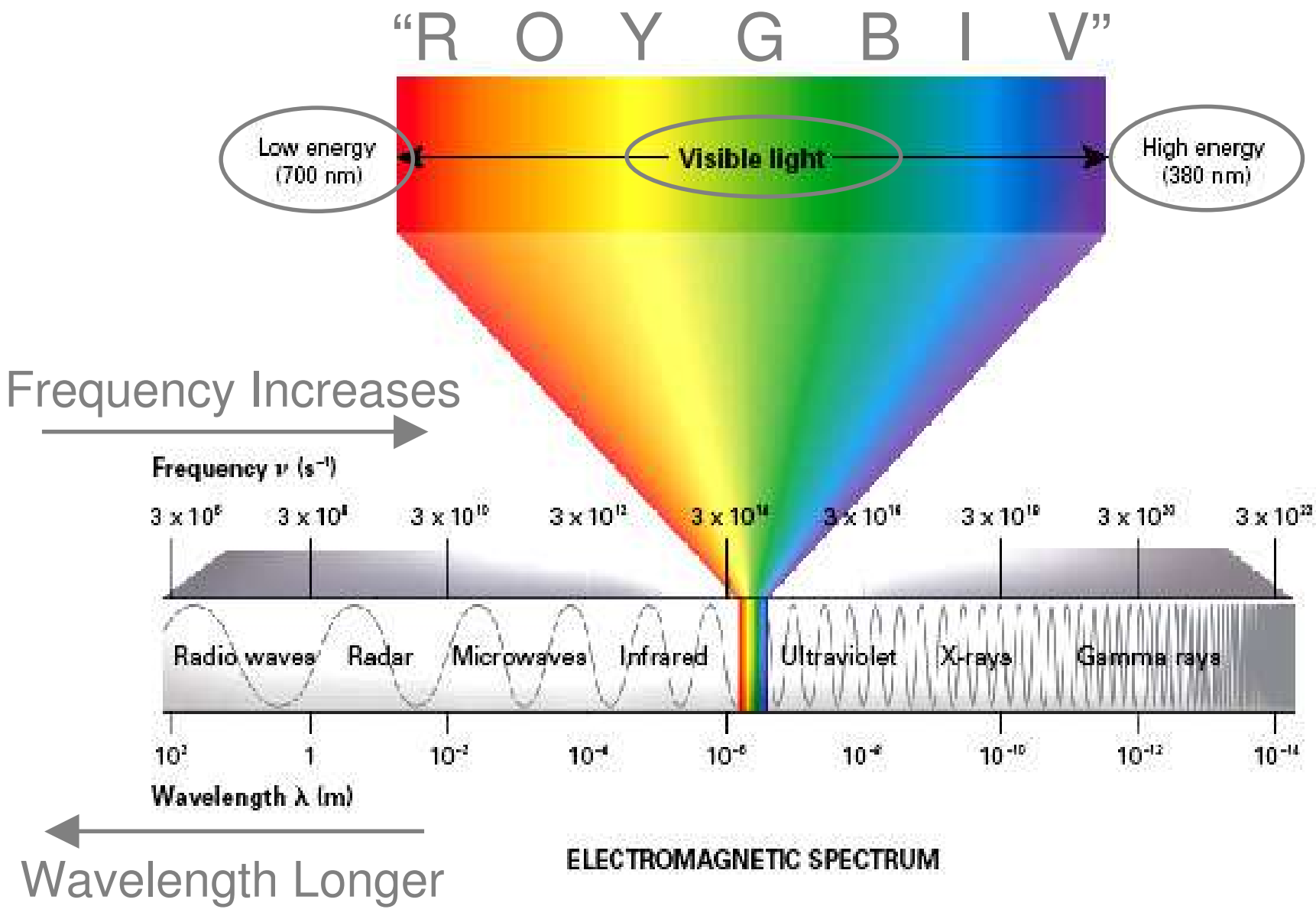
1) Transverse - how high above or how low below the nodal line.

2) Compressional - how dense the medium is at the compressions & rarefactions.

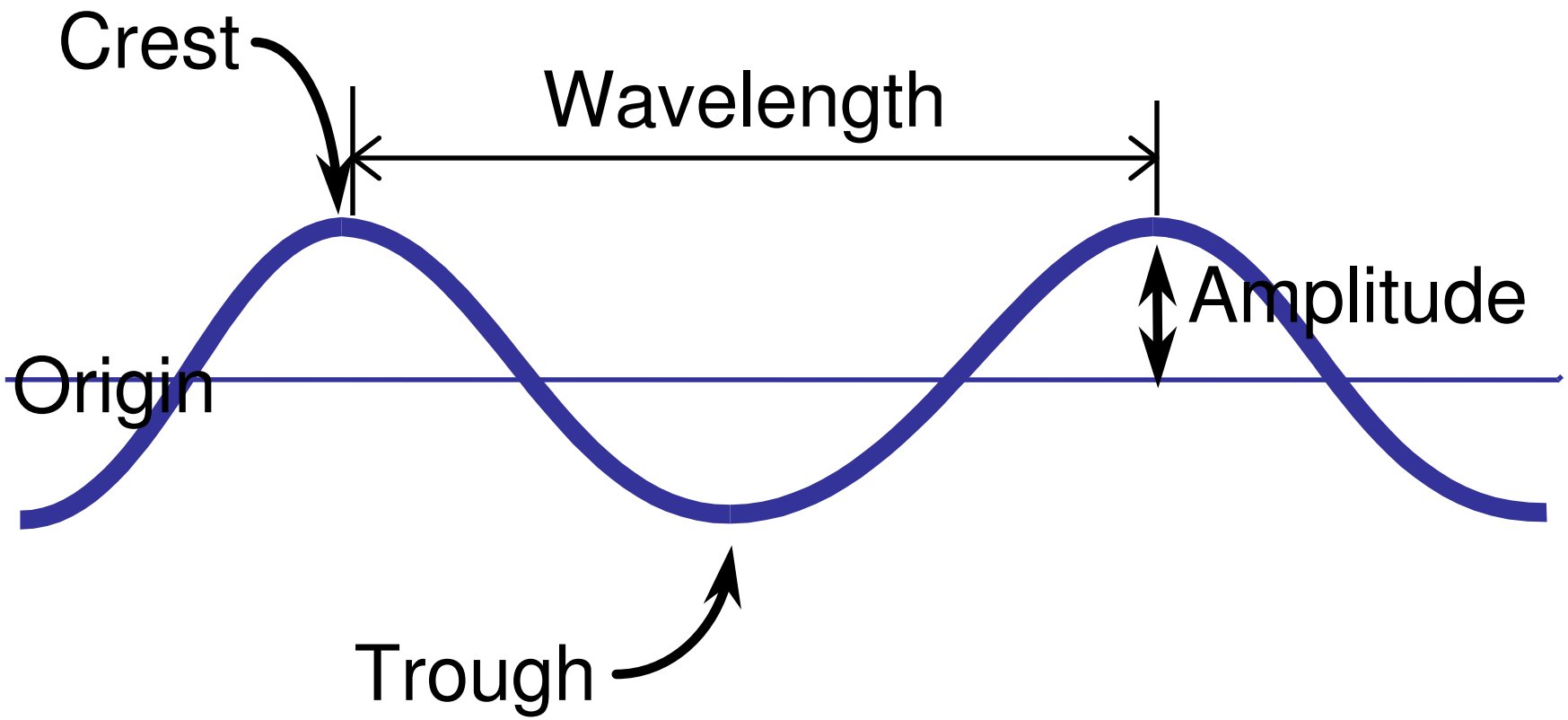
Light

- The study of light led to the development of the quantum mechanical model.
- Light is a kind of electromagnetic radiation.
- Electromagnetic radiation includes many types: gamma rays, x-rays, radio waves…
- Speed of light = 2.998×10^8 m/s, and is abbreviated “c”
- *All electromagnetic radiation* travels at this same rate when measured in a vacuum

63 Figure 5.10 Electromagnetic Spectrum - Page 139



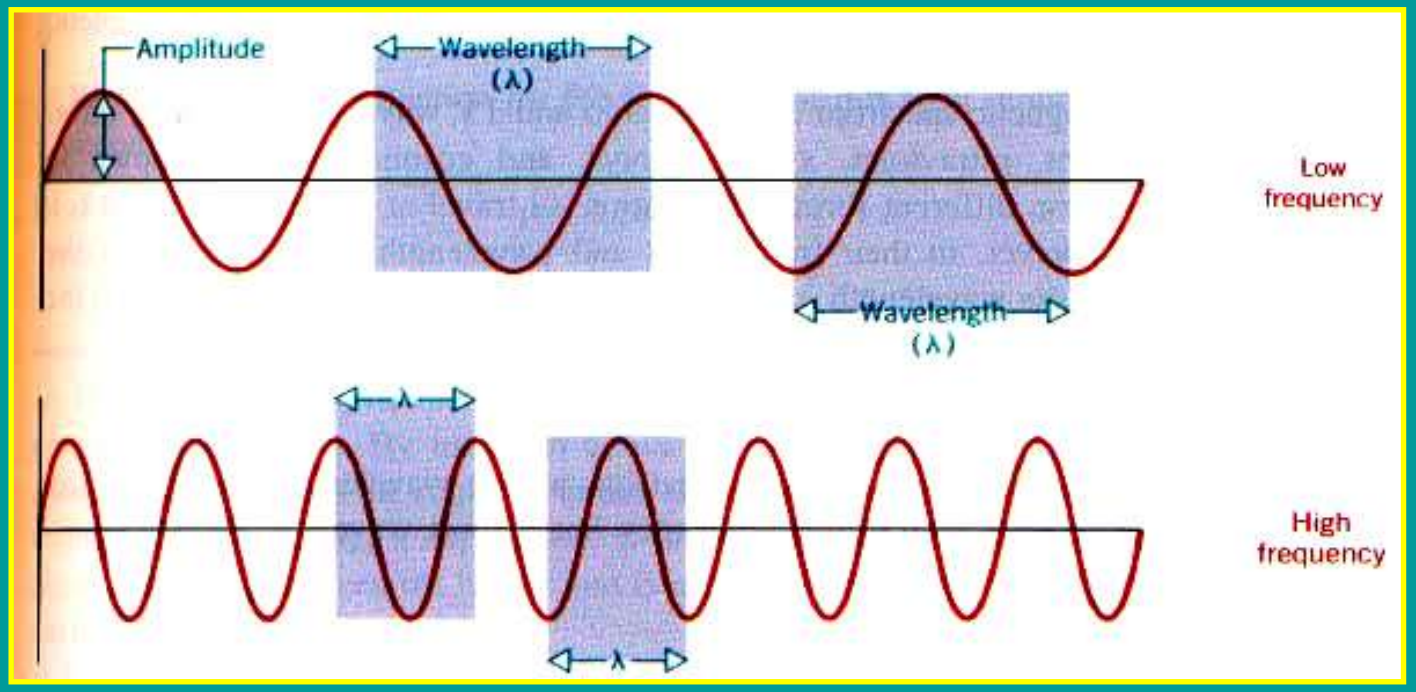
Parts of a wave



Electromagnetic radiation propagates through space as a wave moving at the speed of light.

Equation:

$$\underbrace{c = \lambda\nu}$$



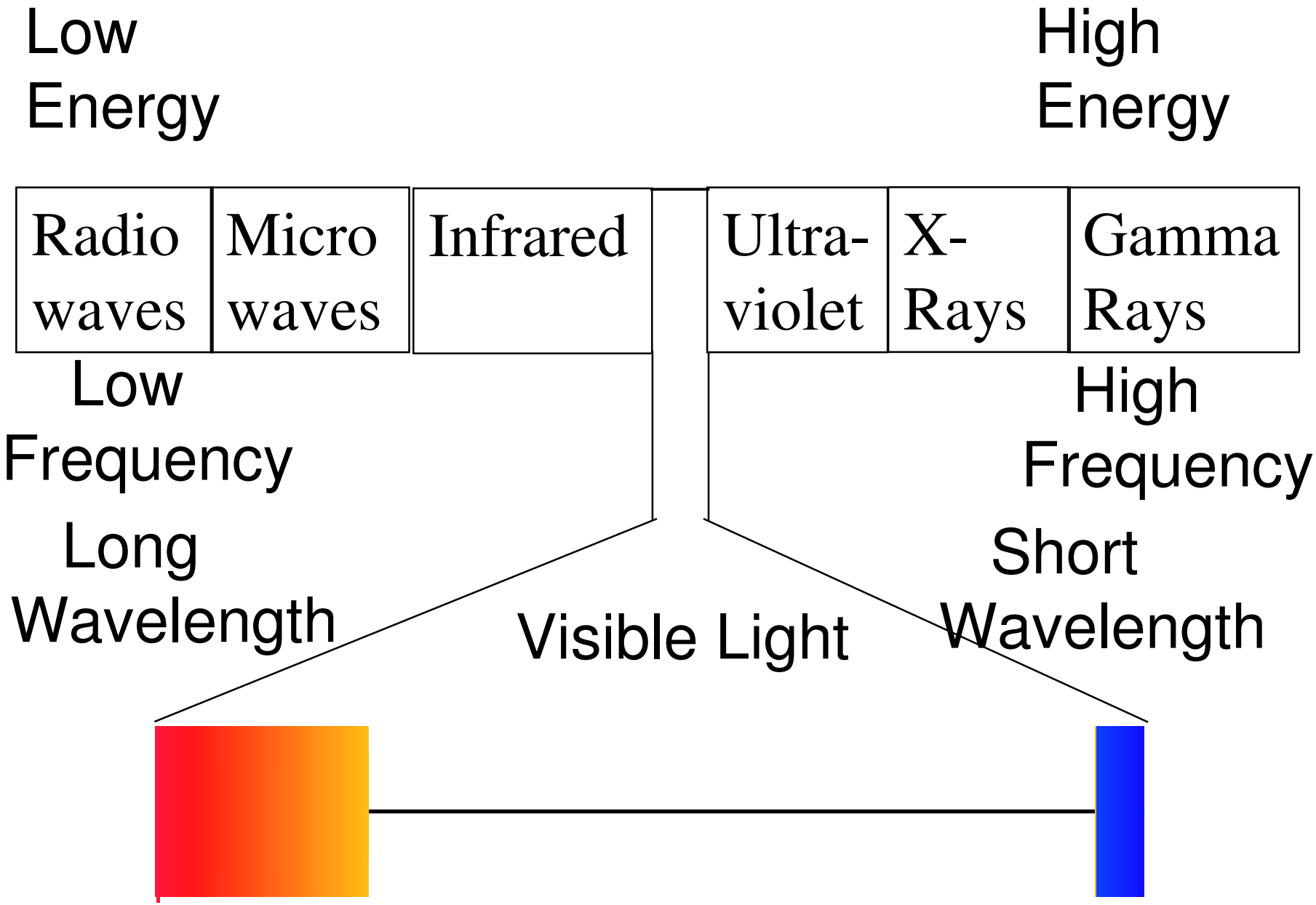
c = speed of light, a constant (2.998 x 10^8 m/s)

λ (lambda) = wavelength, in meters

ν (nu) = frequency, in units of hertz (hz or sec^{-1})

Wavelength and Frequency

- Are inversely related
  - As one goes up the other goes down.
- Different frequencies of light are *different colors* of light.
- There is a wide variety of frequencies
- The whole range is called a spectrum


Low
Energy
High
Energy
Radio waves
Micro waves
Infrared
Ultra-violet
X-Rays
Gamma Rays
Low
Frequency
High
Frequency
Long
Wavelength
Visible Light
Short
Wavelength


Domain 3: Physics- Wave Interactions

Wave behavior:

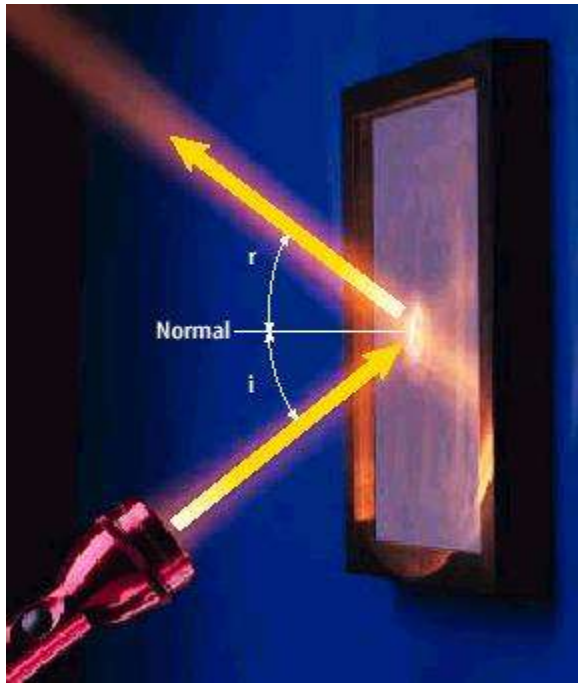
a. Reflection - the bouncing back of a wave.

1) Sound echoes

2) Light images in mirrors

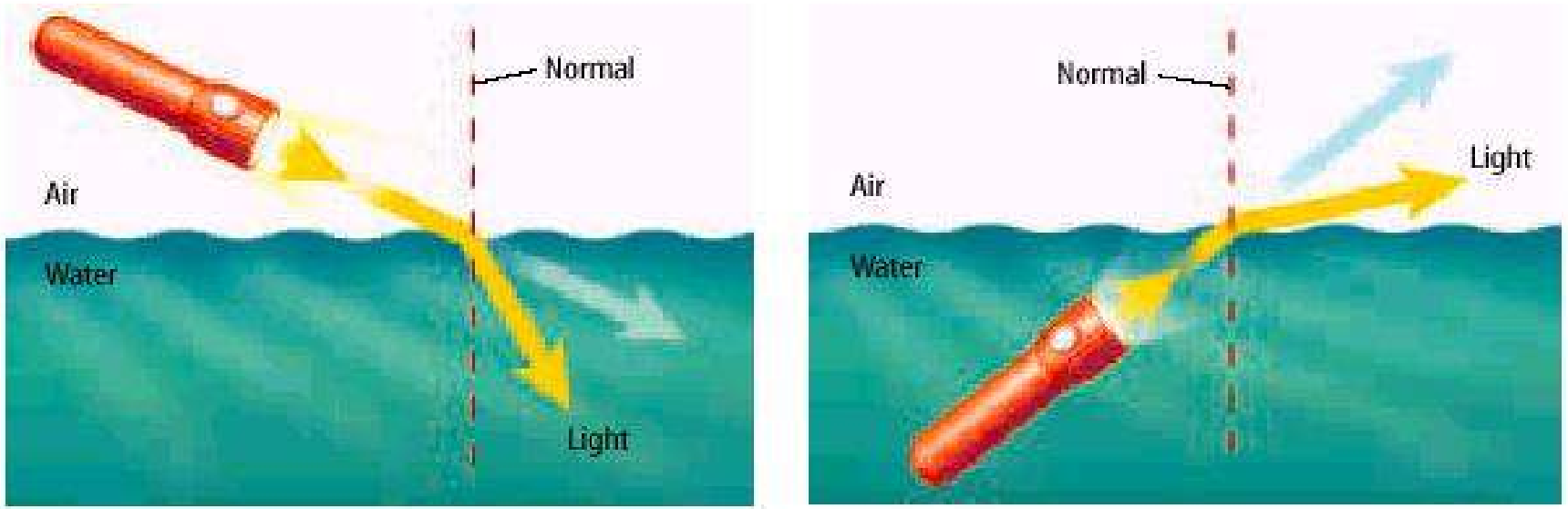
3) Law of reflection

$i = r$



b. Refraction - the bending of a wave caused by a change in speed as the wave moves from one medium to another.

Light travels slower in water than in air.

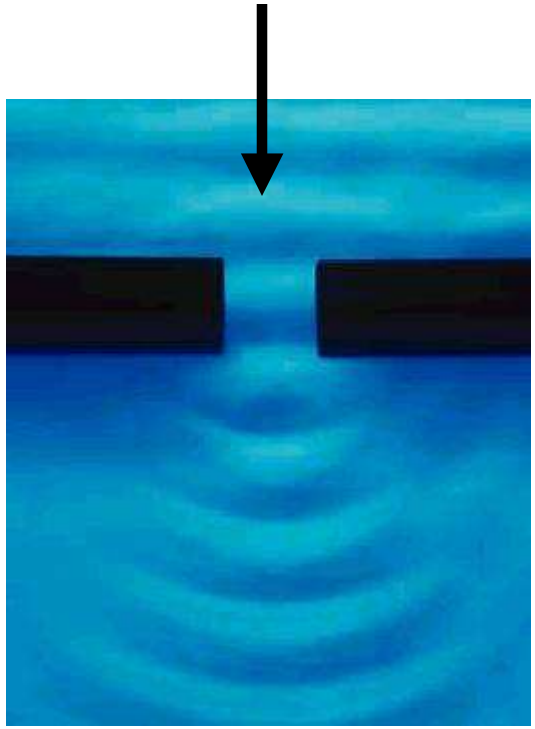


The girl sees the boy's foot closer to the surface than it actually is.

No! He is looking straight down and not at an angle. There is no refraction for him.

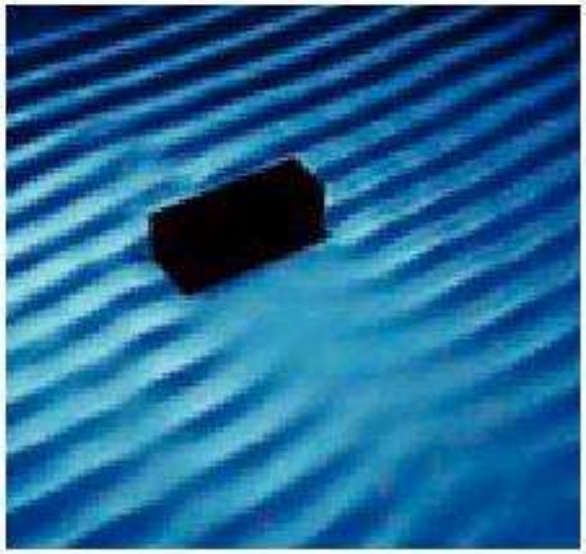
c. Diffraction - the bending of a wave around the edge of an object.

1) Water waves bending around islands

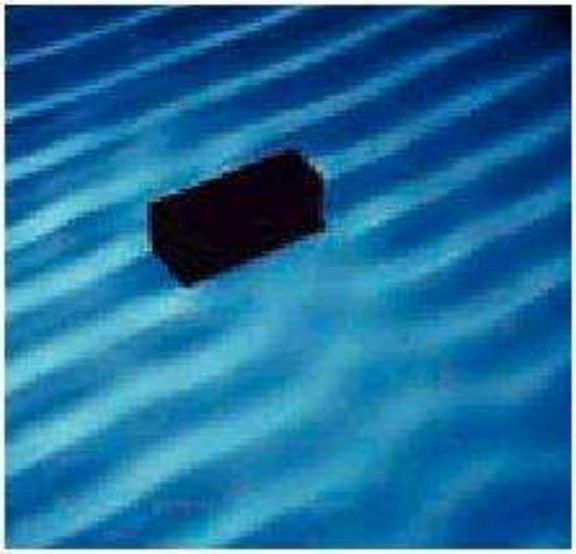


2) Water waves passing through a slit and spreading out

3) Diffraction depends on the size of the obstacle or opening compared to the wavelength of the wave.

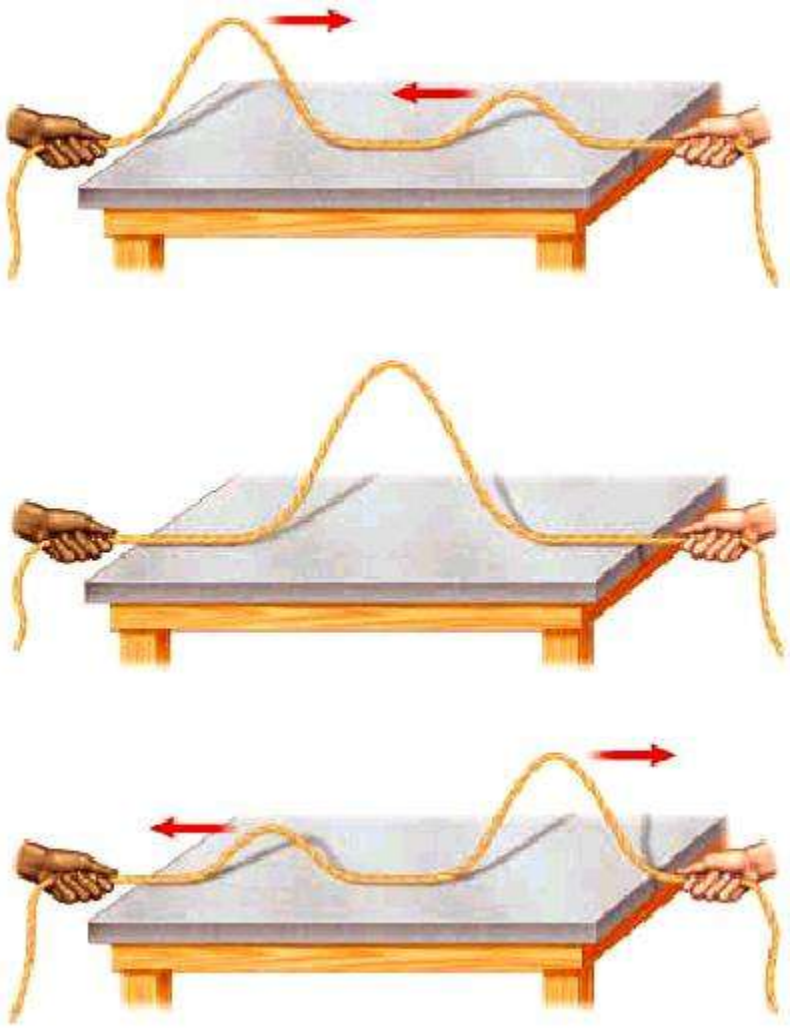


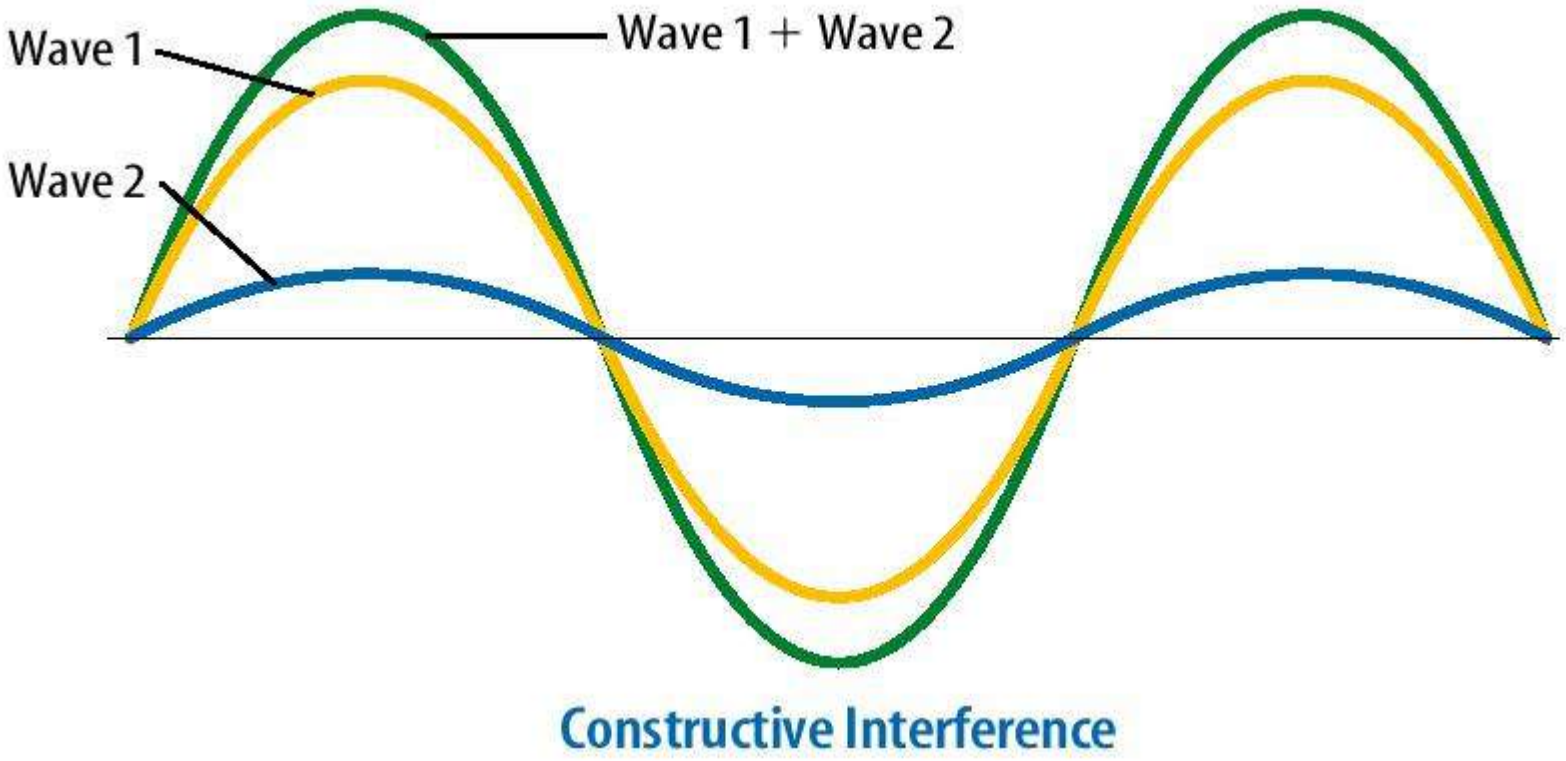
Less occurs if wavelength is smaller than the object.



More occurs if wavelength is larger than the object.

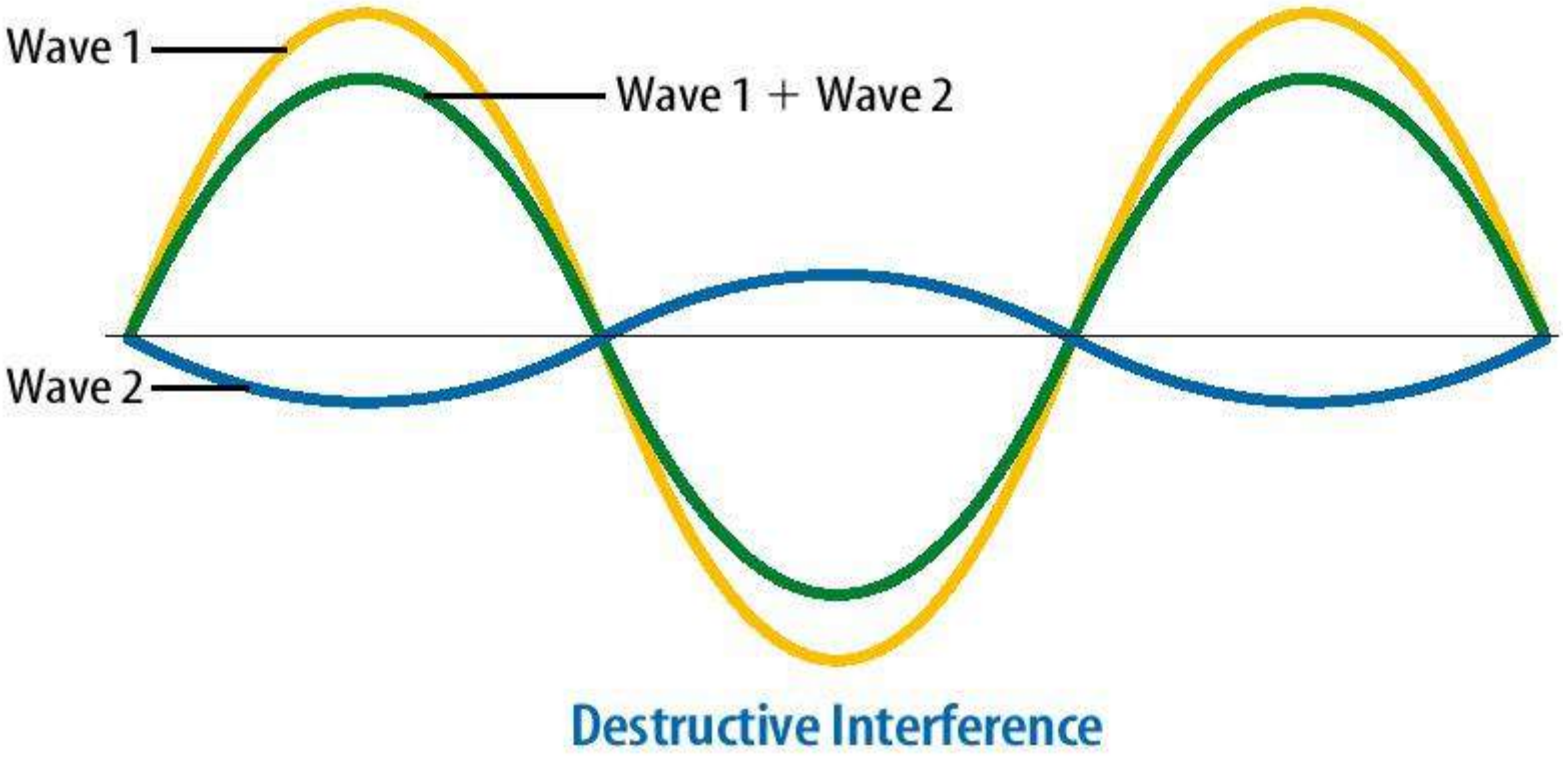
d. Interference - two or more waves overlapping to form a new wave.





1) Constructive (in phase)

Sound waves that constructively interfere are louder



2) Destructive (out of phase)

Sound waves that destructively interfere are not as loud

4) AM radio waves are longer and can diffract around large buildings and mountains; FM can't.

5) Ultrasonic sound has a frequency greater than 20,000 Hz.

a) Dogs (up to 35,000 Hz)

b) Bats (over 100,000 Hz)

c) Medical diagnosis

6) Infrasonic sound has a frequency below 20 Hz; they are felt rather than heard

(earthquakes, heavy machinery).

c. Speed of sound

1) 332 m/s in air at 0 C.

2) Changes by 0.6 m/s for every Celsius degree from 0 C.

3) Subsonic – slower

4) Supersonic – faster than sound (Mach 1 = speed of sound)

5) Sonic boom (pressure cone)

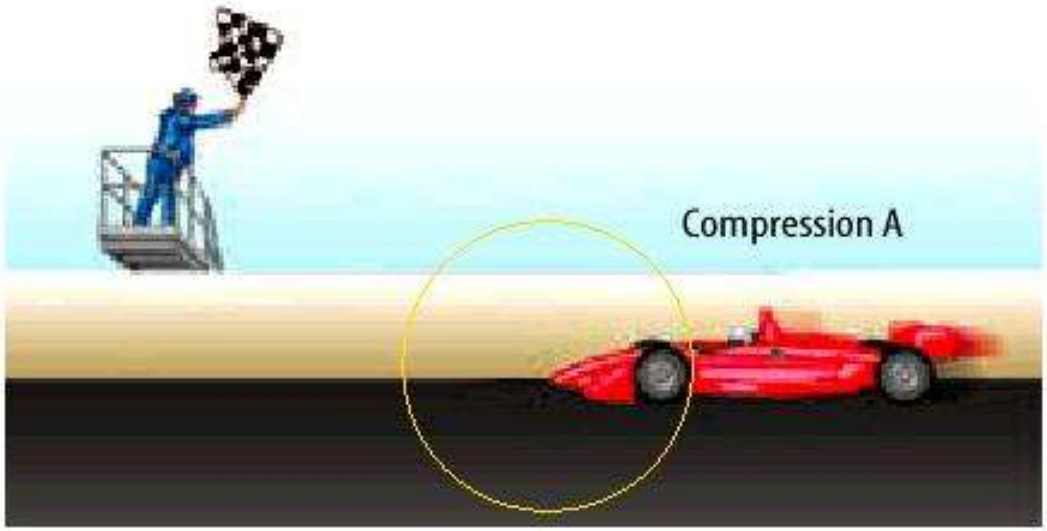
d. The Doppler effect – the change in pitch due to a moving wave source.

1) Objects moving toward you cause a higher pitched sound.

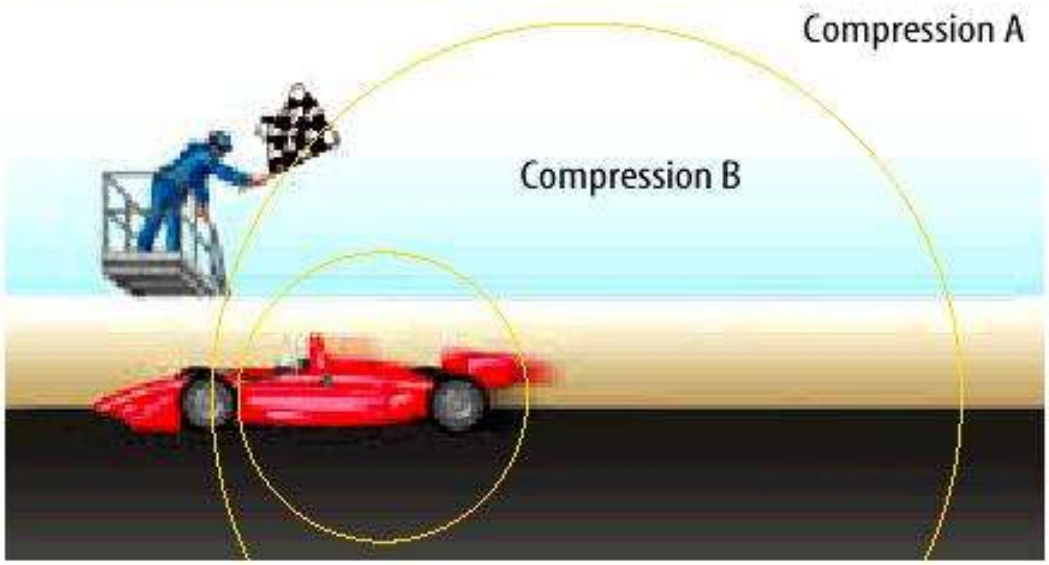
2) Objects moving away cause sound of lower pitch.

3) Used in radar by police and meteorologists and in astronomy.

The Doppler effect occurs when the source of a sound wave is moving relative to a listener.



A The race car creates compression A.



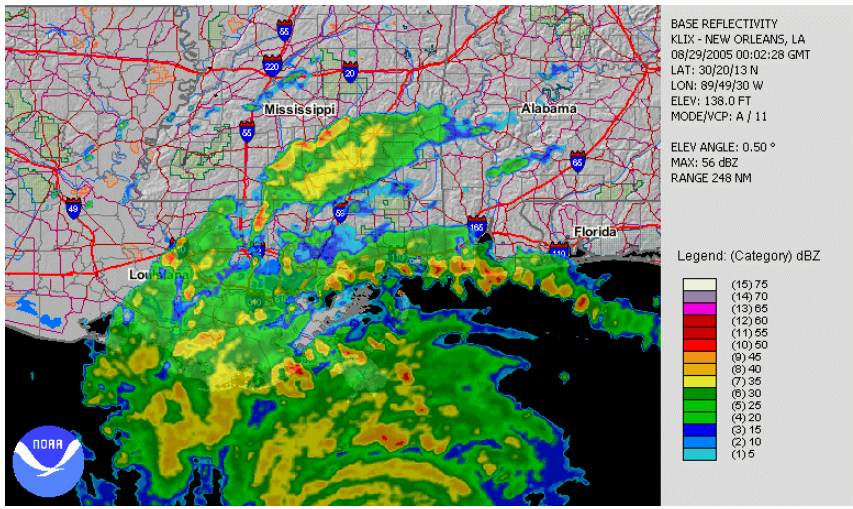
B The car is closer to the flagger when it creates compression B. Compressions A and B are closer together in front of the car, so the flagger hears a higher-pitched sound.

d. The Doppler effect – the change in pitch due to a moving wave source.

1) Objects moving toward you cause a higher pitched sound.

2) Objects moving away cause sound of lower pitch.

3) Used in radar by police and meteorologists and in astronomy.




Domain 3: Physics-
Electricity and Magnetism

Charged Particles

- Neutrons have no charge
- Neutrons have no effect on the charge
- Charges in objects can produce a force between the objects
- Objects are forced together or attracted when their charges are different
- “Opposite charges attract”
- Same electric charges they push apart
- “Like charges repel”

Generating a static discharge

- Electrons can be moved around
- Rubbing fur or cloth against rubber (like a balloon) will move some electrons from the cloth to the balloon
- Both the cloth and the balloon will have a charge.
- What will the charge on the balloon be?
- What will the charge on the cloth be?

Electric Field

- Don’t have to touch to feel a charge.
- An electric field surrounds all charged objects.
- Electric forces act at a distance because or this field.

Static Electricity

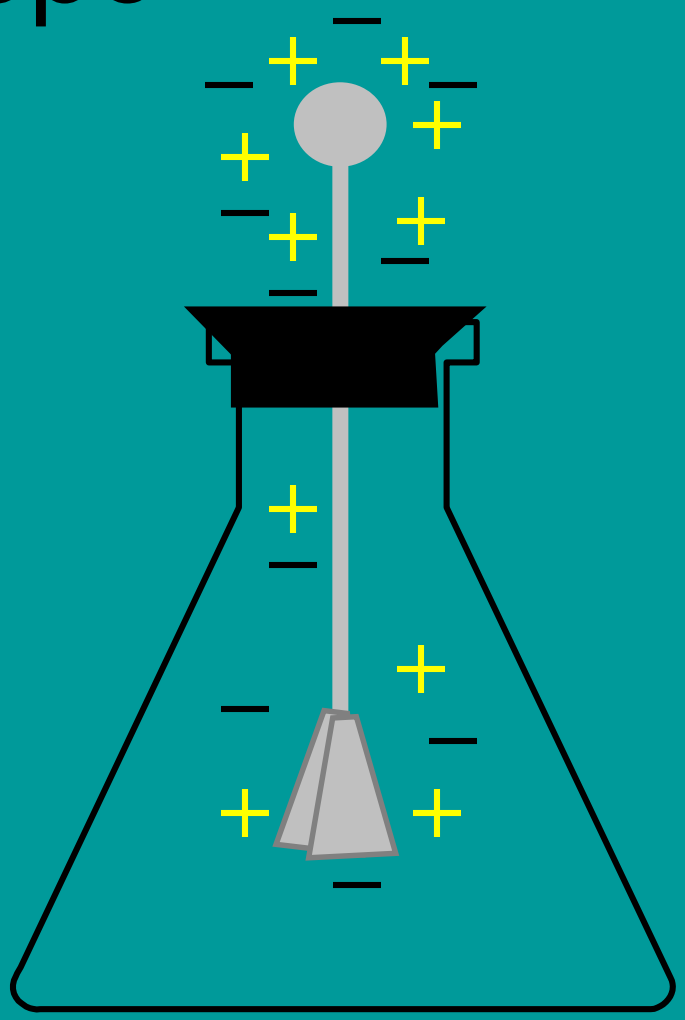
- Static means not moving
- Static electricity is electricity at rest
- Friction can cause it
- Objects rub together and electrons move from one object another.

Two ways to move electrons

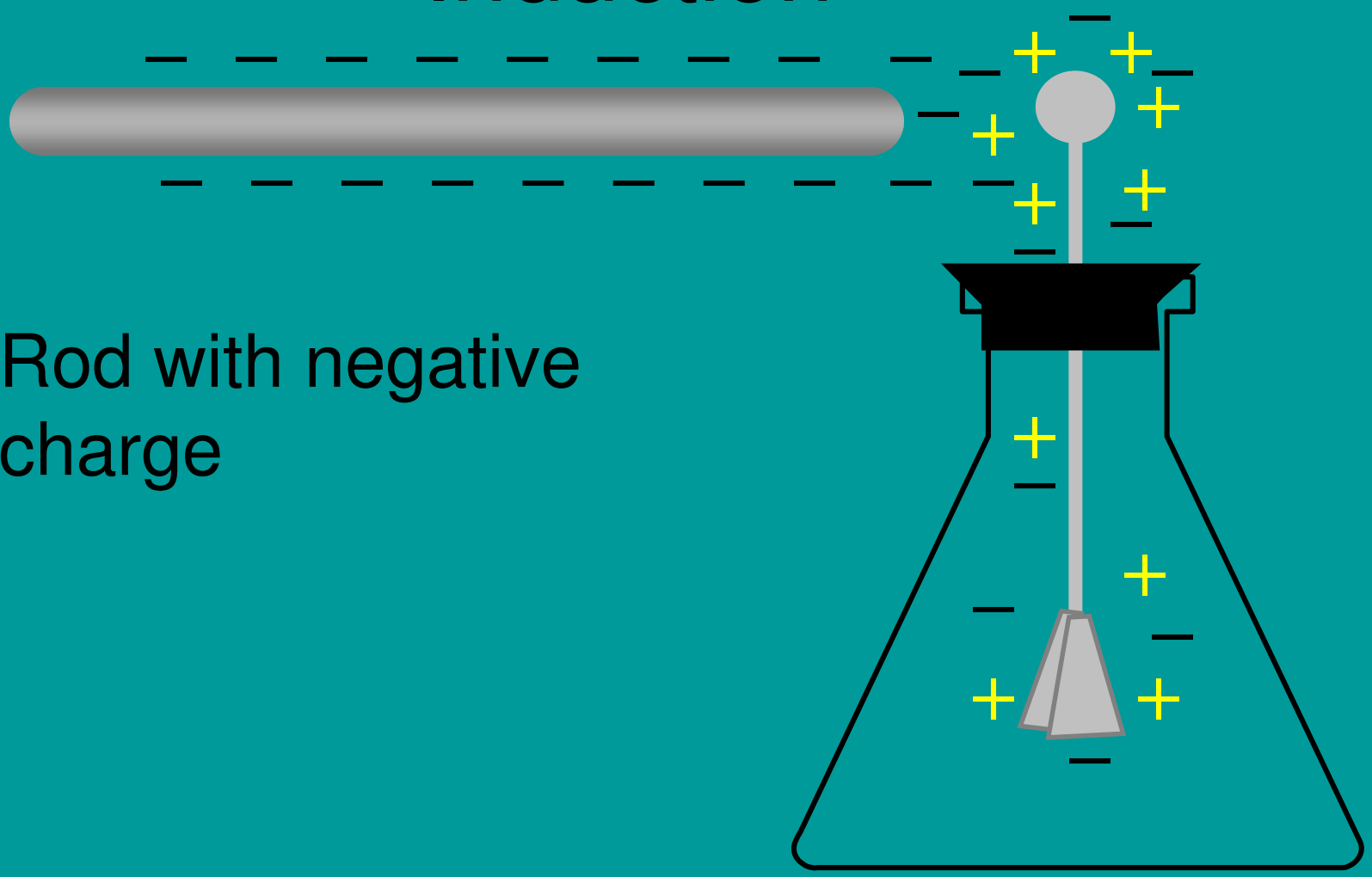
- Conduction: electrons are transferred by direct contact.
- Induction: electrons on an object are rearranged without physical contact.

Electroscope

No Charge-
leaves hang
straight down

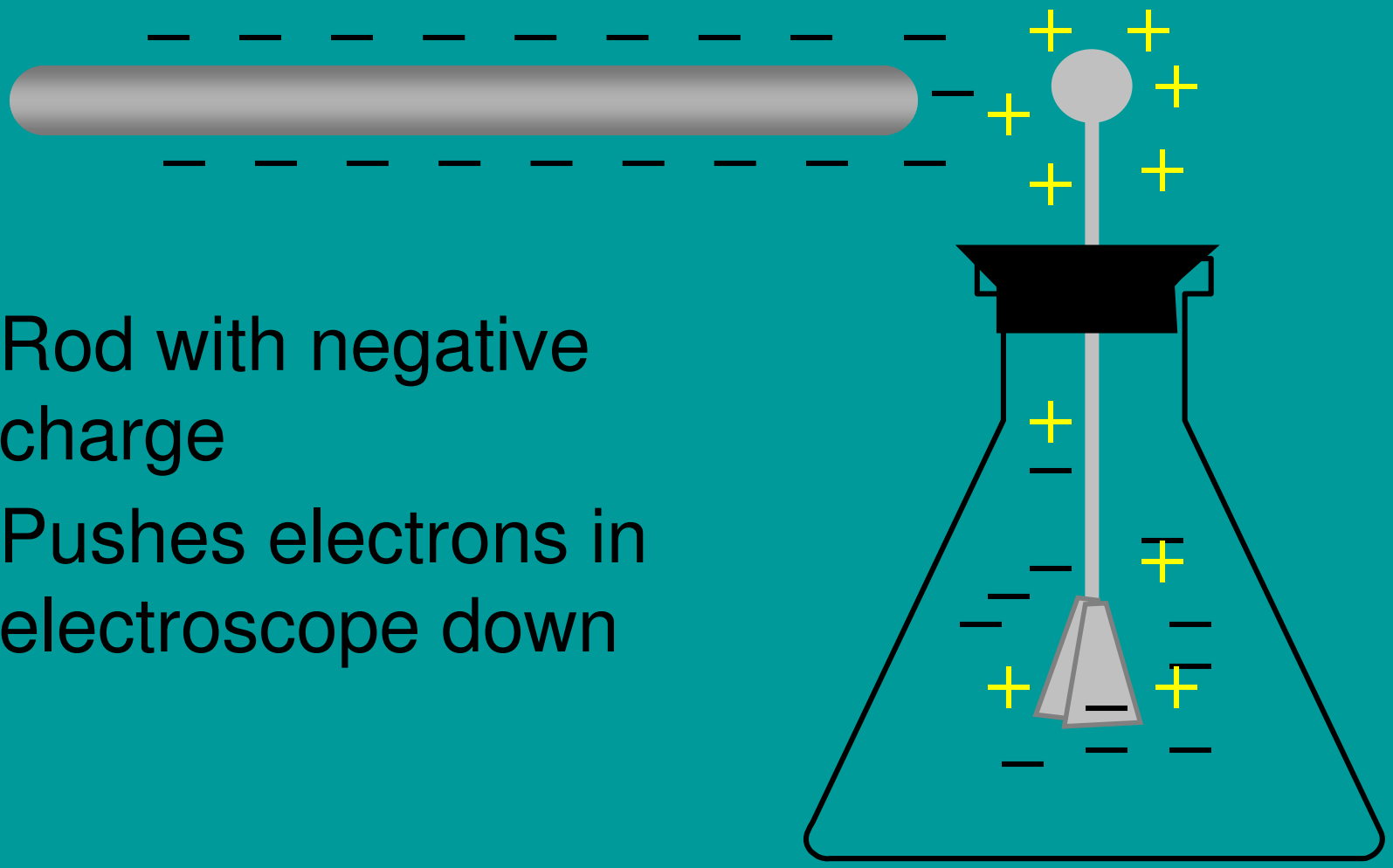


Induction



Rod with negative charge

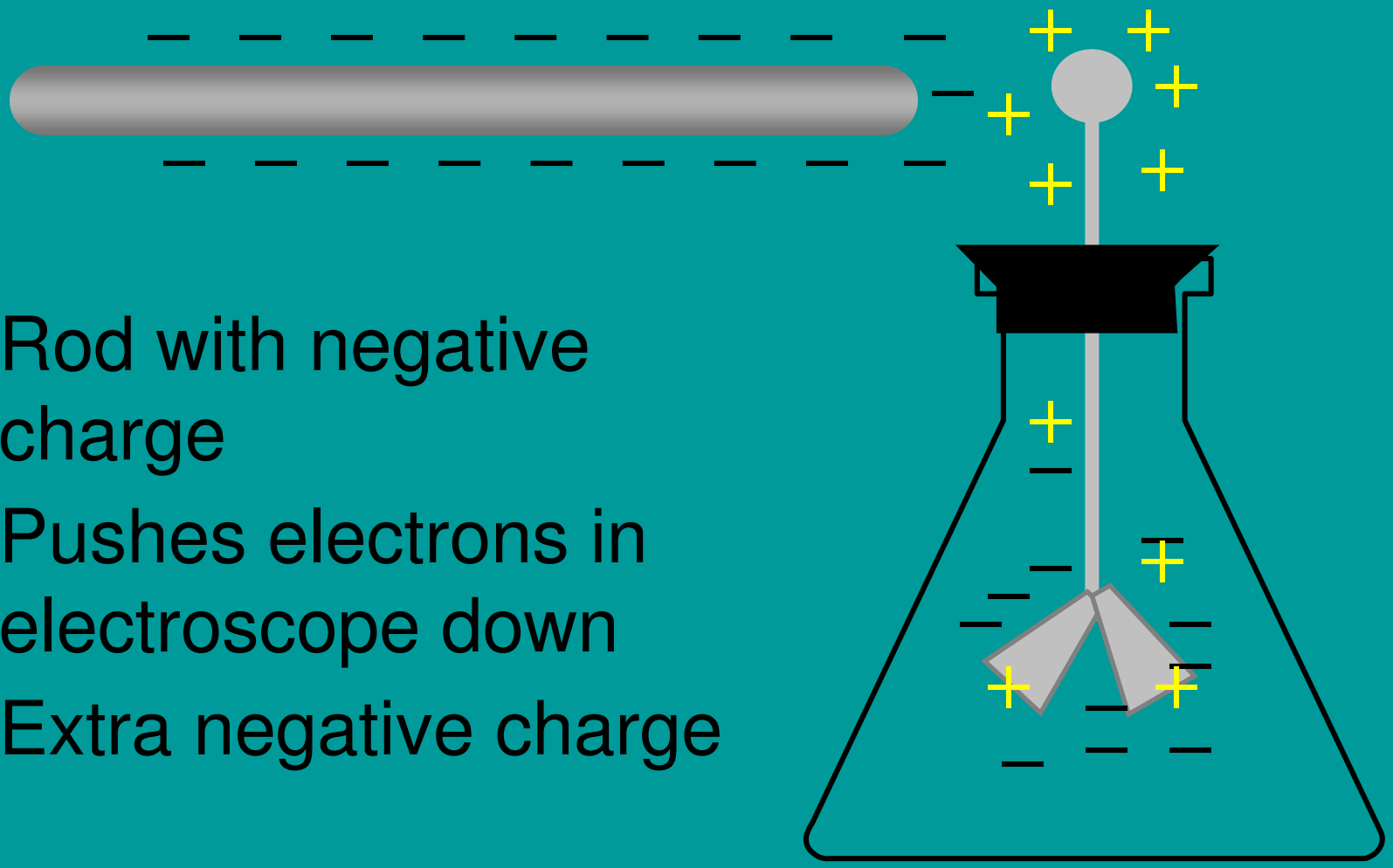
Induction



Rod with negative charge

Pushes electrons in electroscope down

Induction

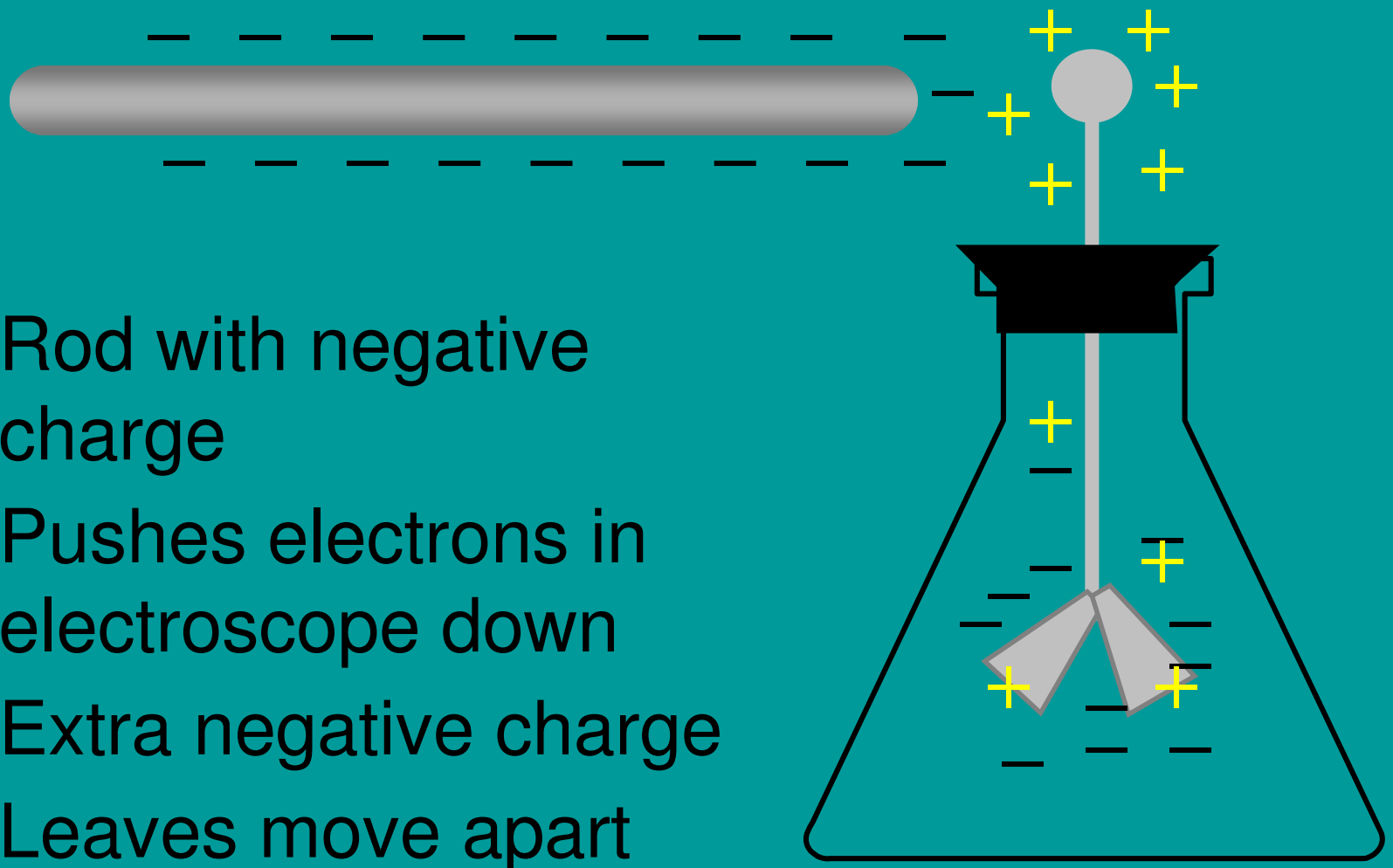


Rod with negative charge

Pushes electrons in electroscope down

Extra negative charge

Induction



Rod with negative charge

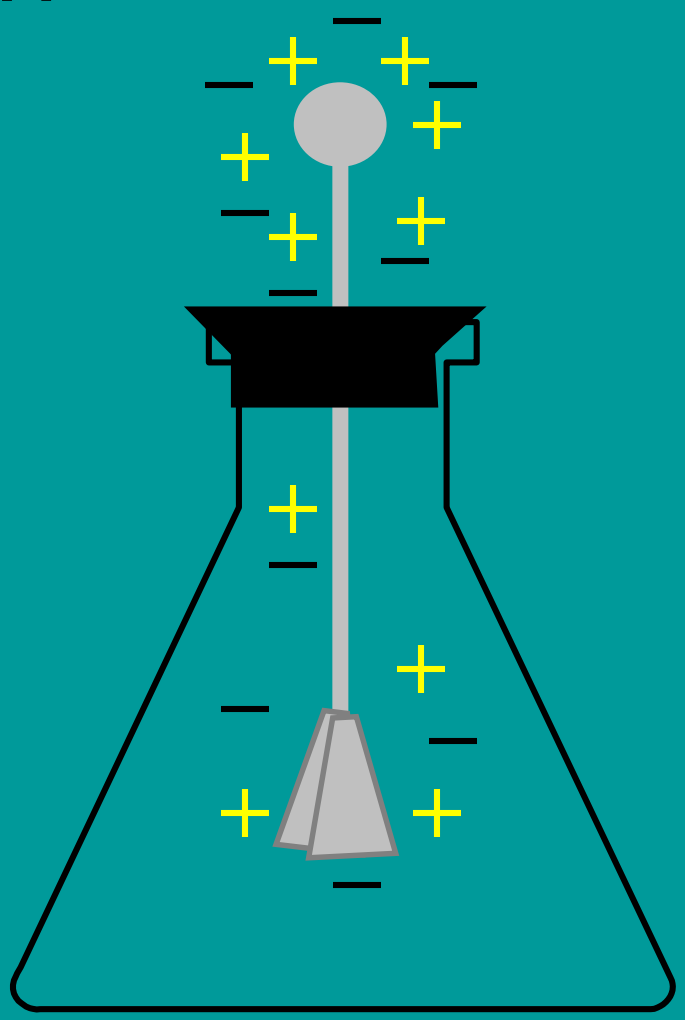
Pushes electrons in electroscope down

Extra negative charge

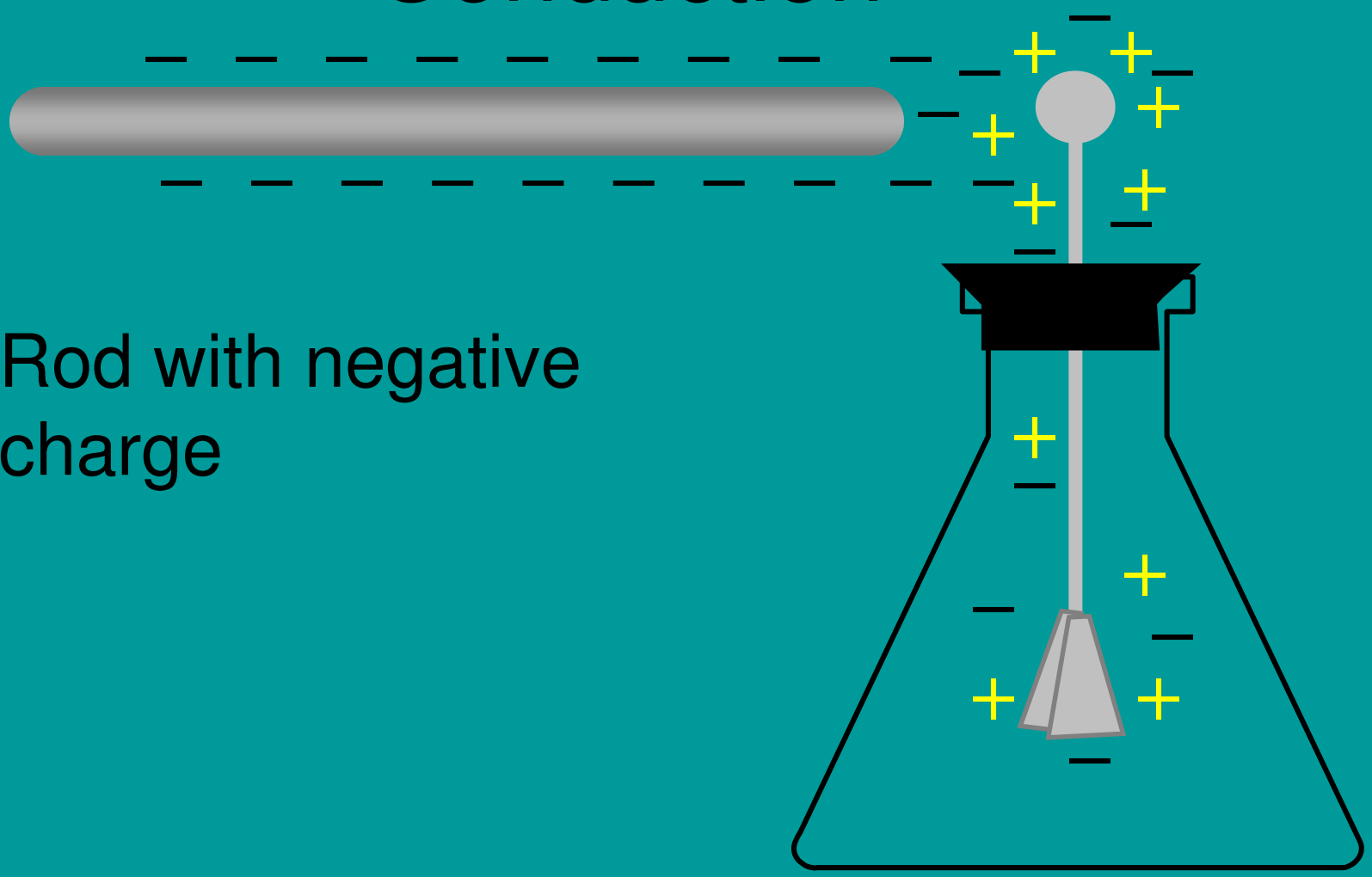
Leaves move apart

Induction

Remove rod
everything returns



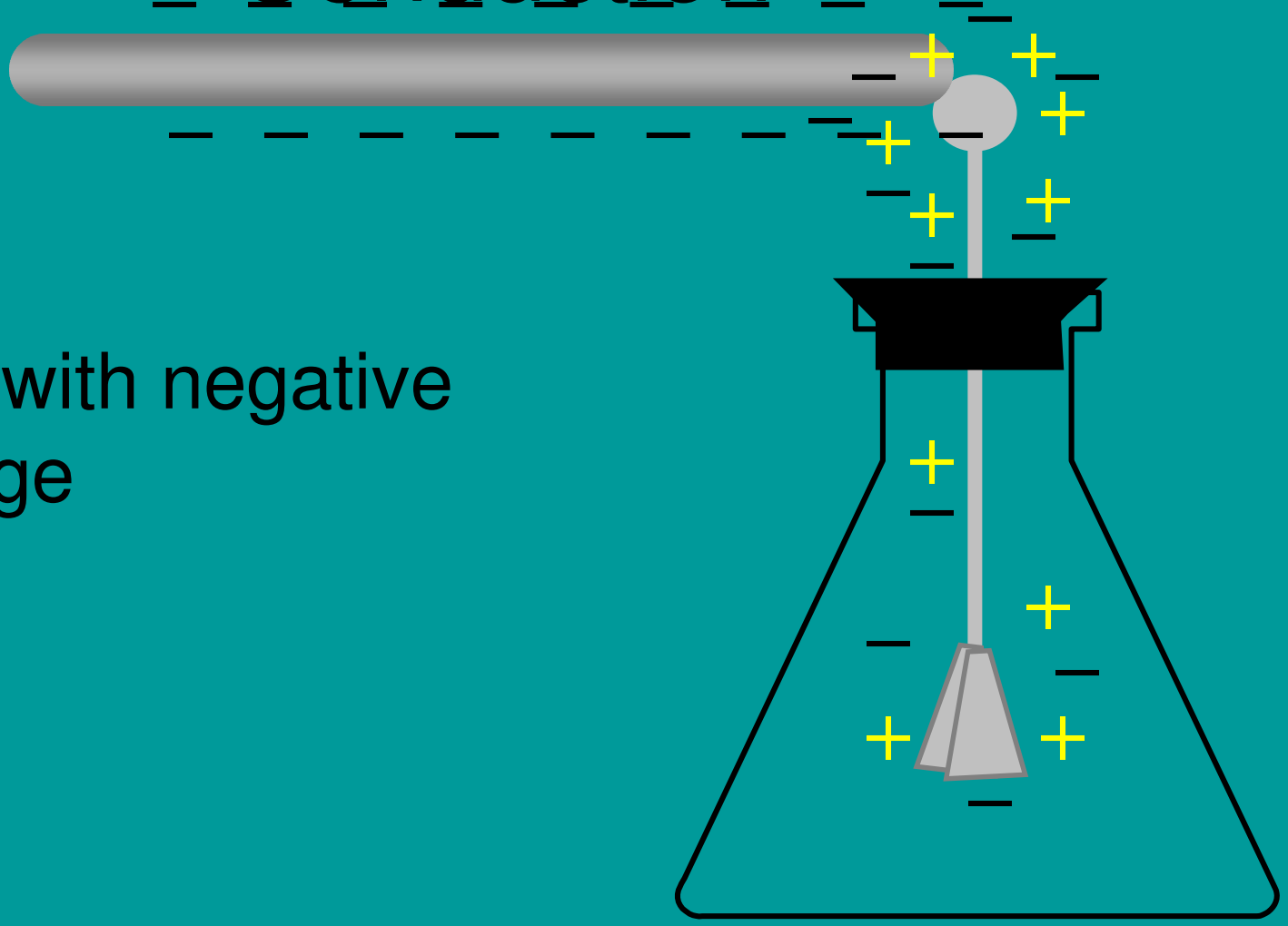
Conduction



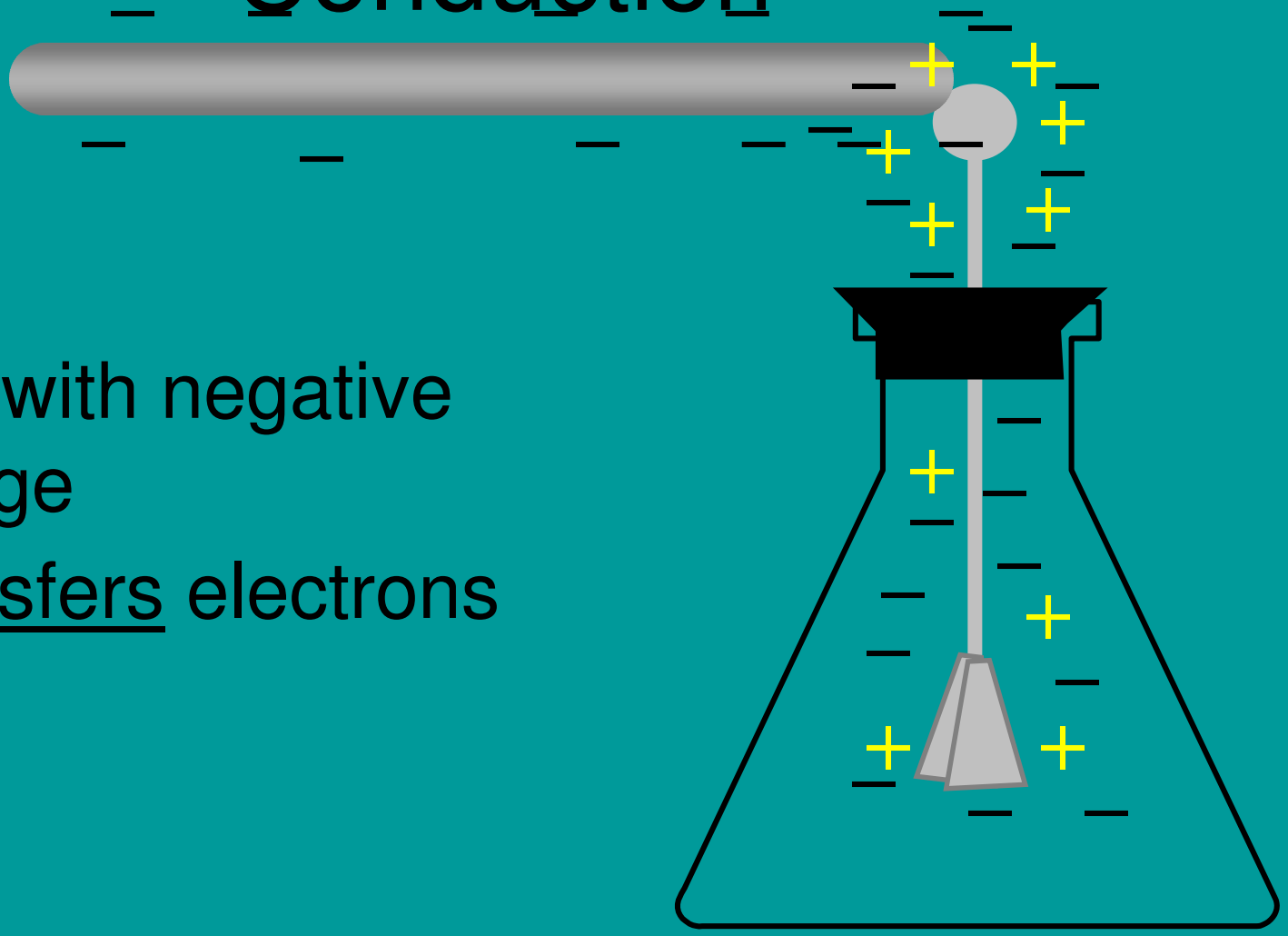
Rod with negative charge

Conduction

Rod with negative charge



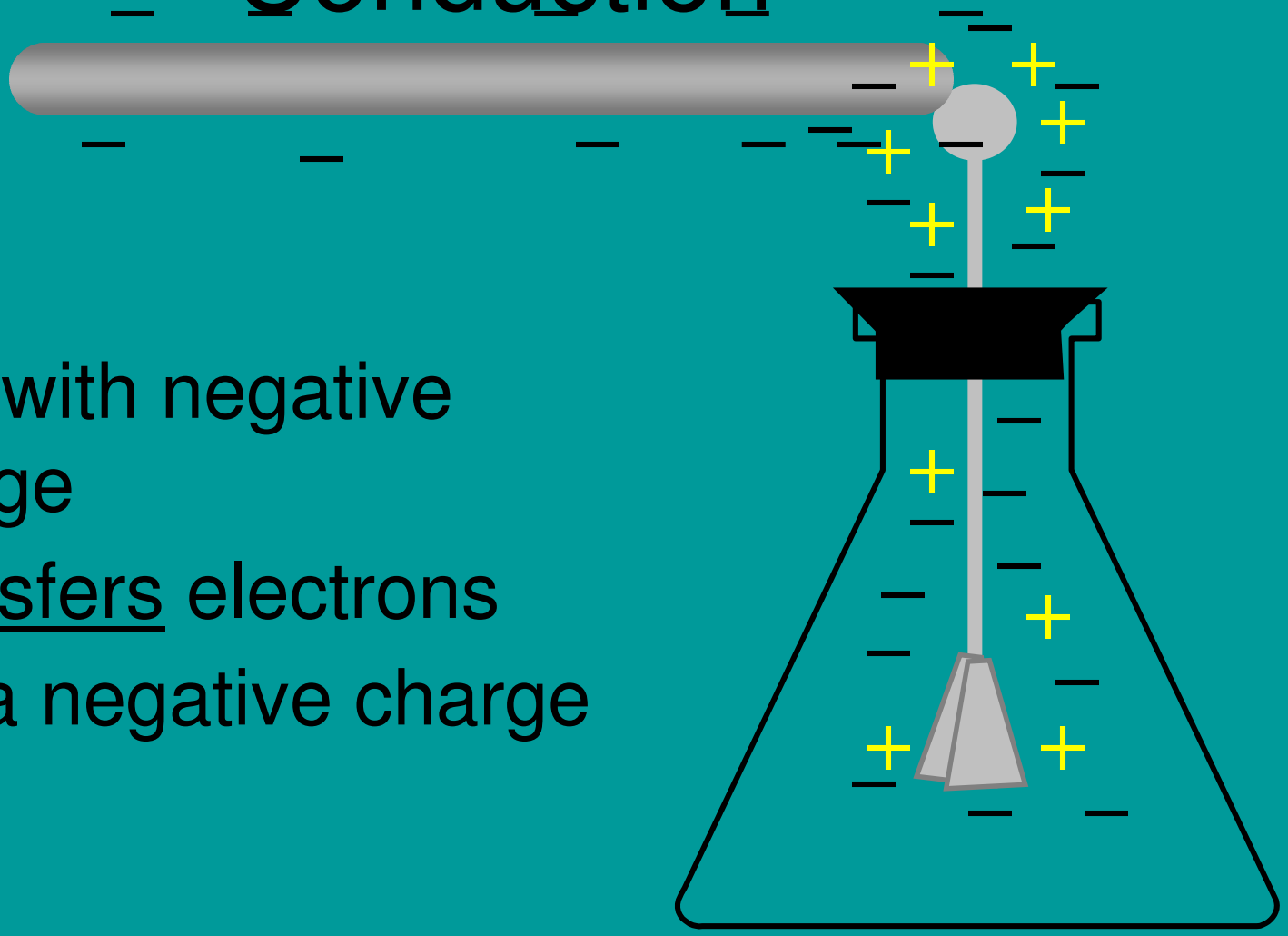
Conduction



Rod with negative charge

Transfers electrons

Conduction

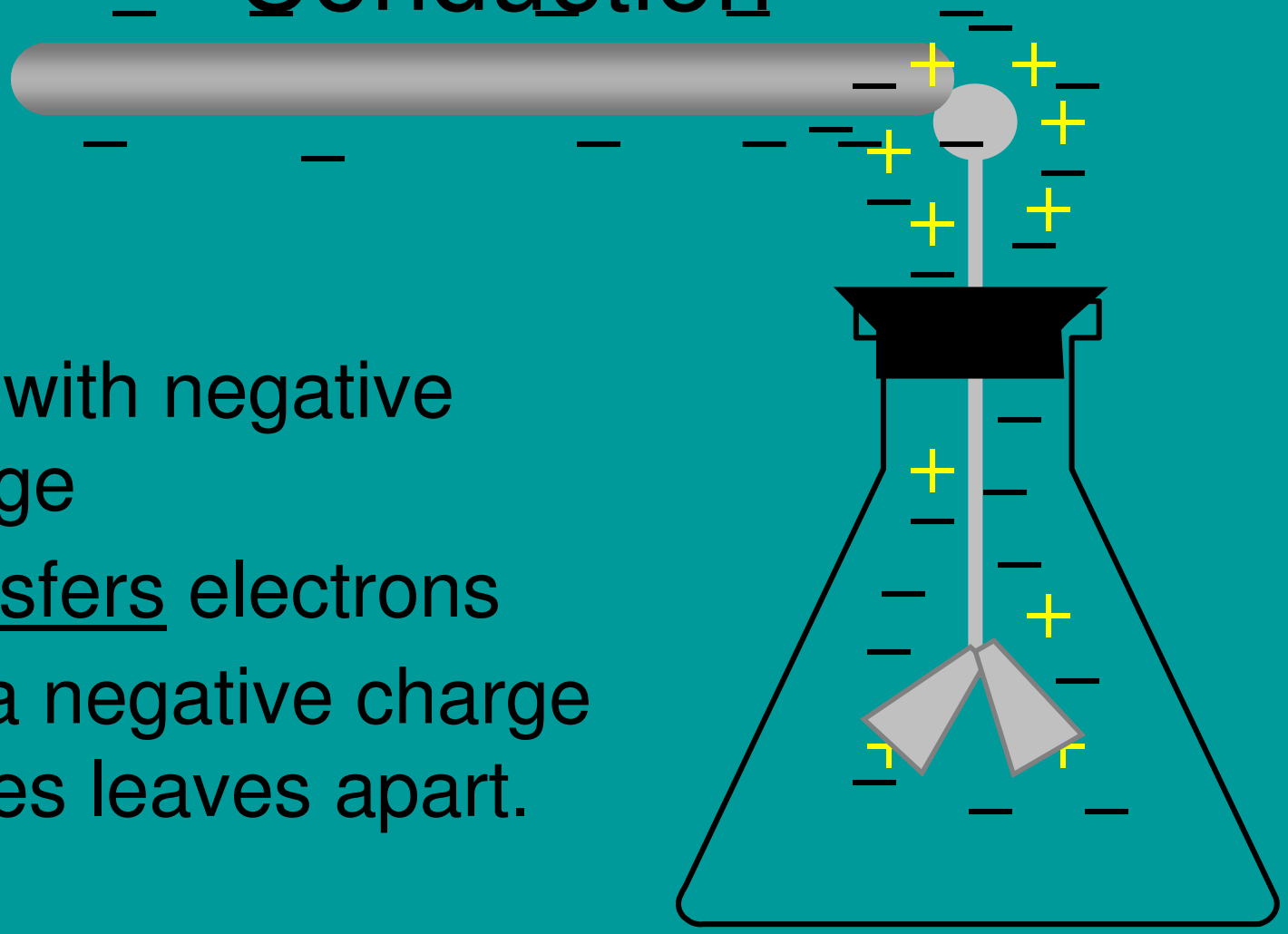


Rod with negative charge

Transfers electrons

Extra negative charge

Conduction



Rod with negative charge

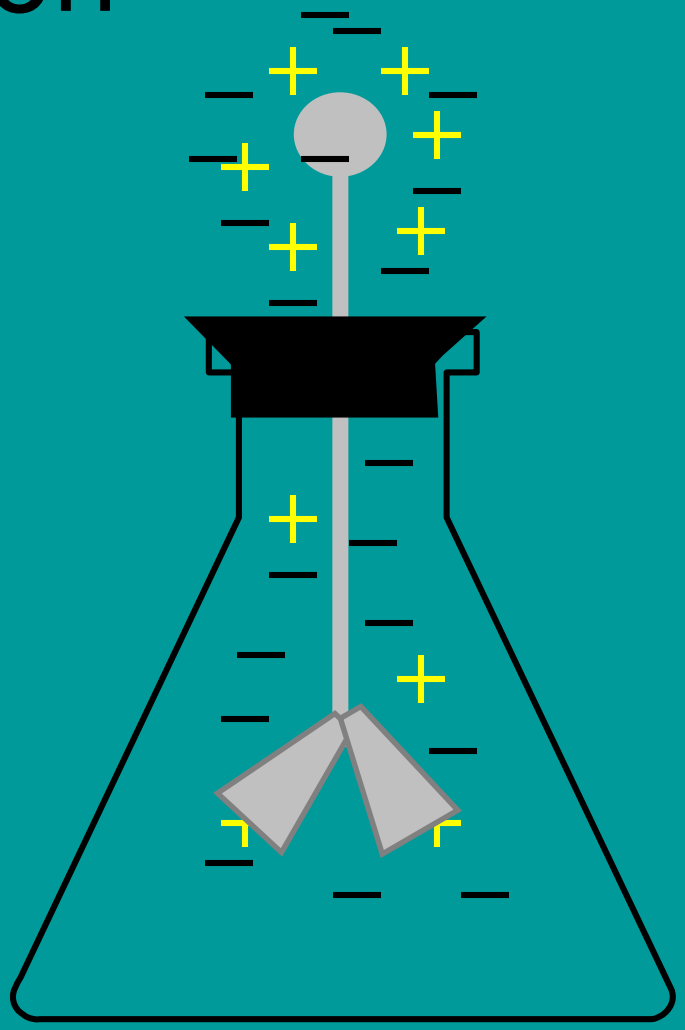
Transfers electrons

Extra negative charge

Moves leaves apart.

Conduction

Remove rod leaves stay apart.



Static discharge

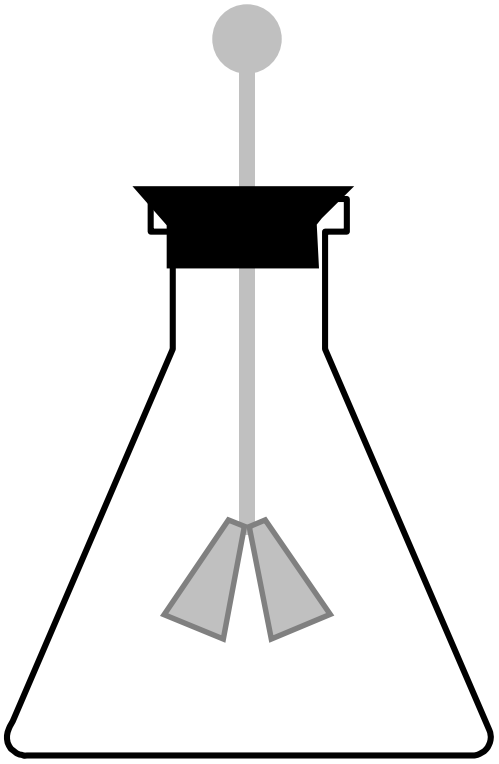
- Eventually static electric charge will move.
- Slowly the electrons may move into moisture in the air
- Or quickly in a spark.

Two types of materials

- Conductors: a material through which electric charges move easily.
- Metals are good conductors
- Insulators: a material through which electric charges can't move easily.
- Plastics, rubber, ceramics, wood

Electroscope

- Flask
- Metal bar (conductor) through rubber stopper (insulator)
- Two pieces of thin foil on the bottom
- Charge on the metal will push the foil apart
- because they have the same charge

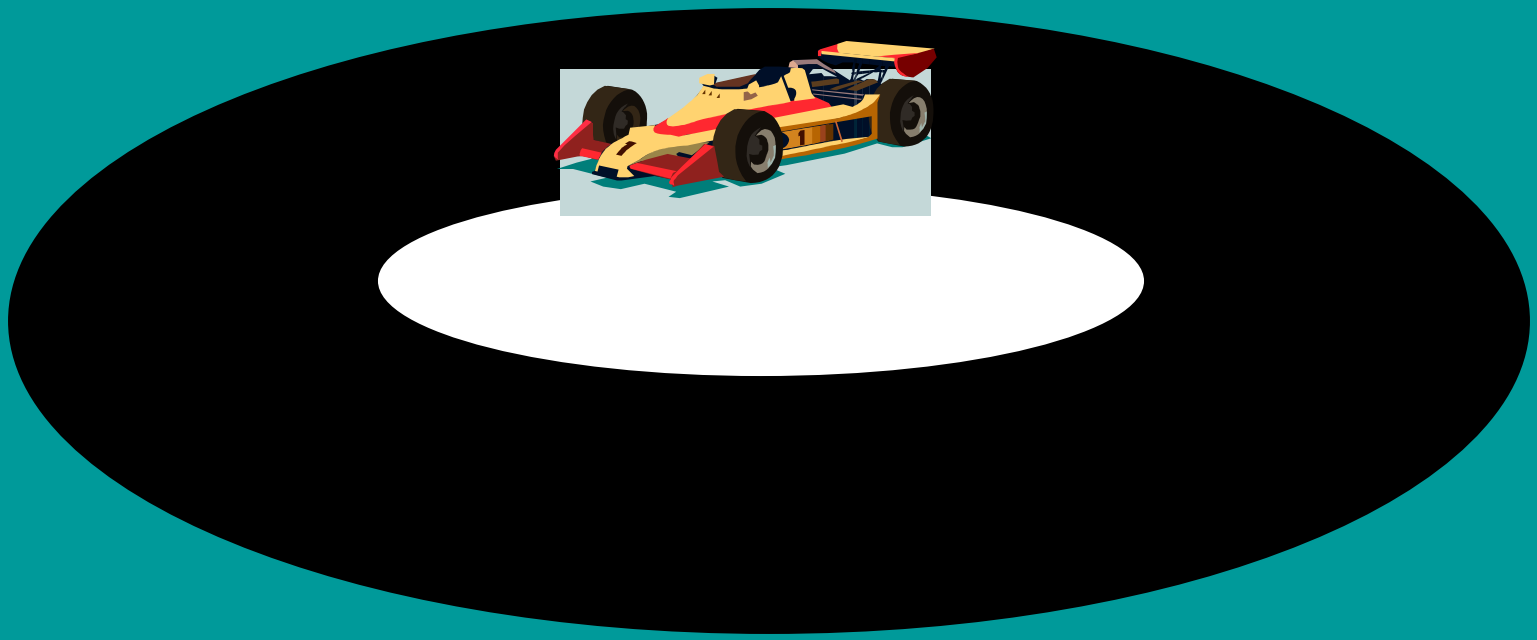


Electricity that moves…

- Current: The flow of electrons from one place to another.
- Measured in amperes (amps)
- Kinetic energy

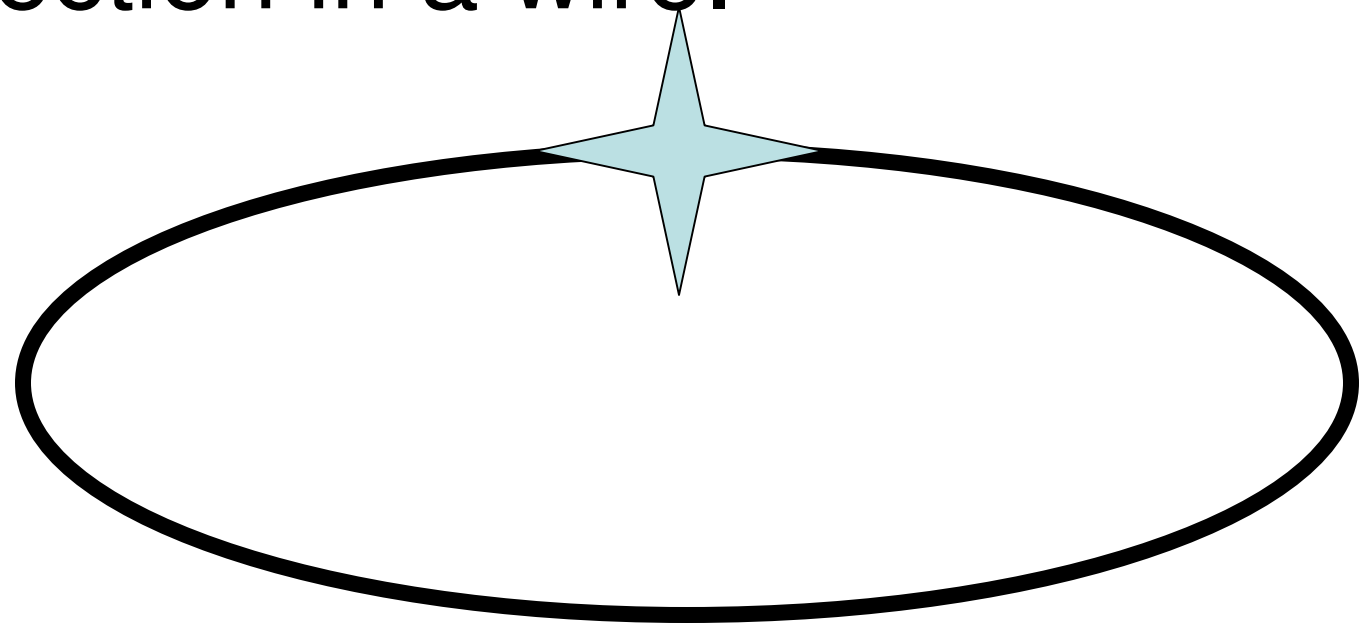
How can we control currents?

- With circuits.
- Circuit: is a path for the flow of electrons. We use wires.



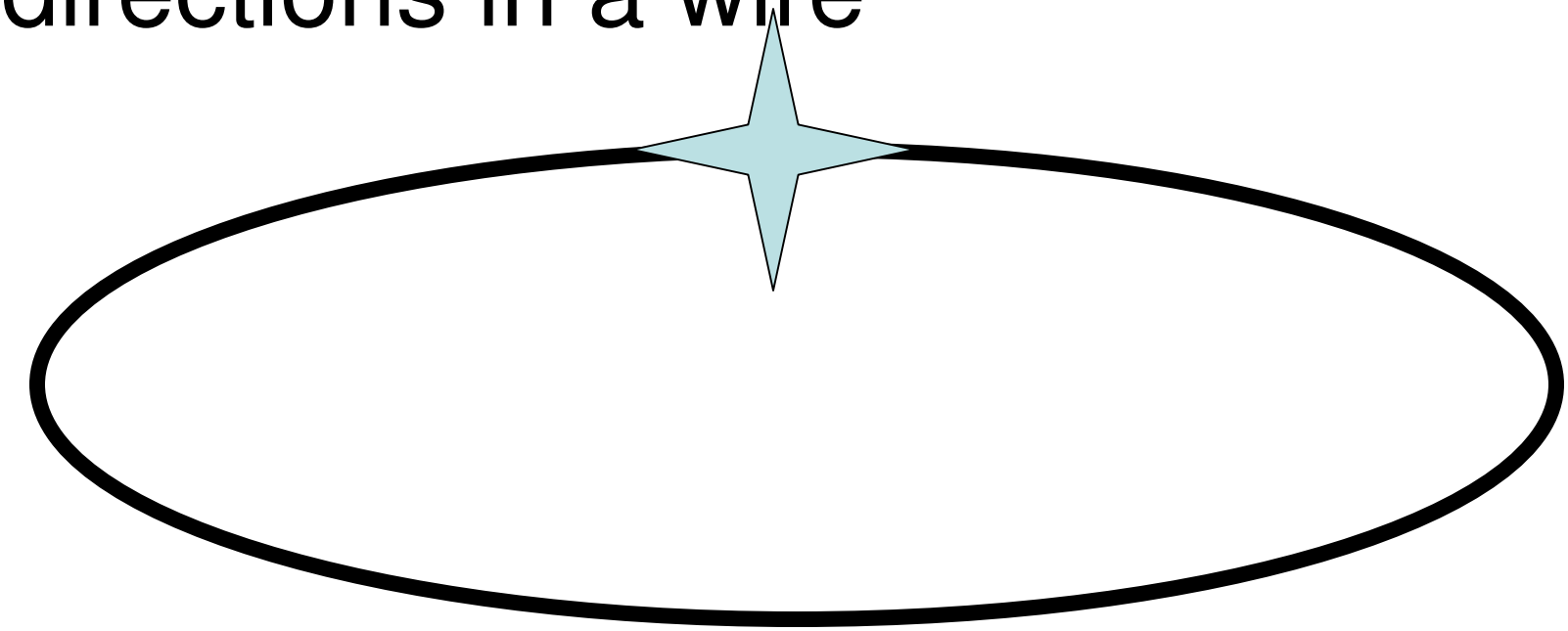
There are 2 types of currents:

- Direct Current (DC) – Where electrons flow in the same direction in a wire.



There are 2 types of currents:

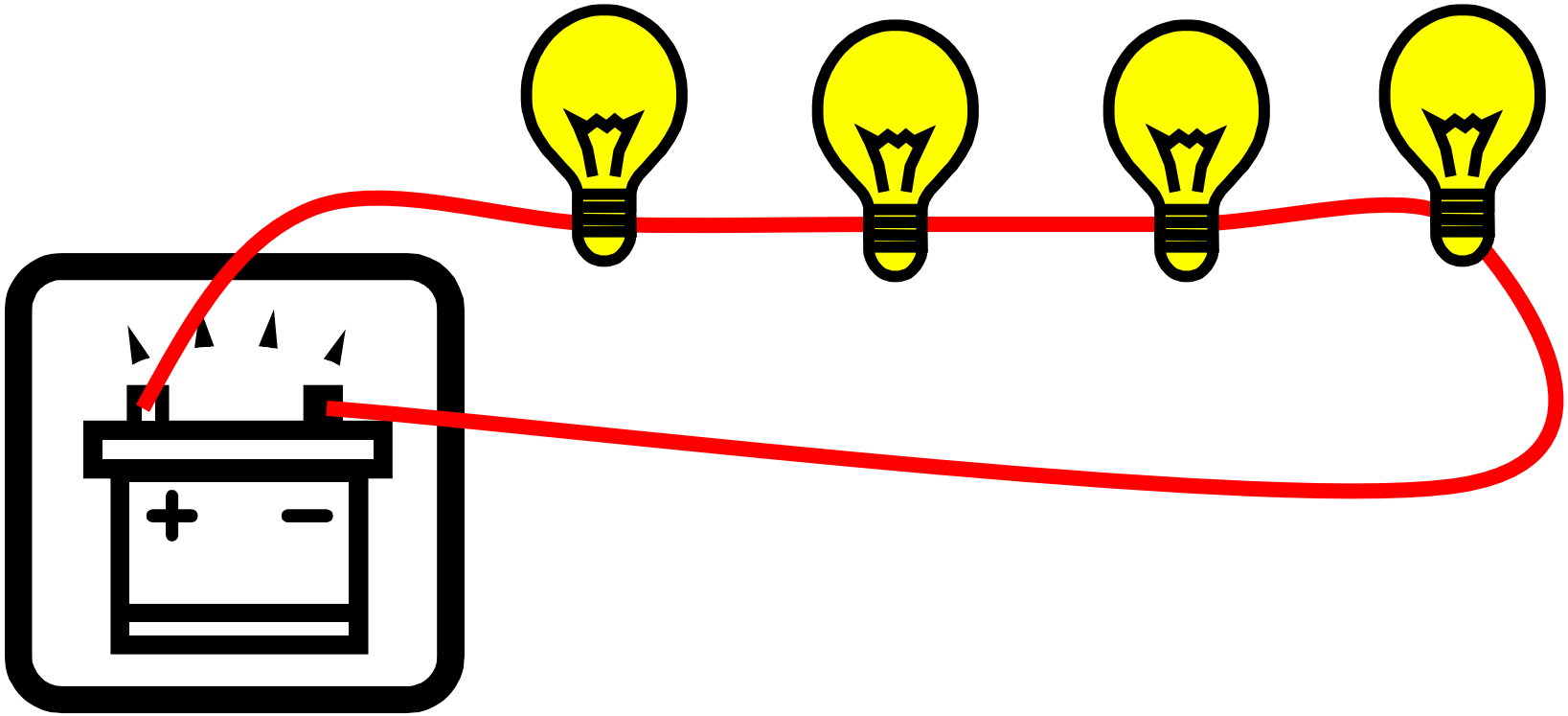
- Alternating Current (AC) – electrons flow in different directions in a wire



There are 2 types of circuits:

- Series Circuit: the components are lined up along one path. If the circuit is broken, all components turn off.

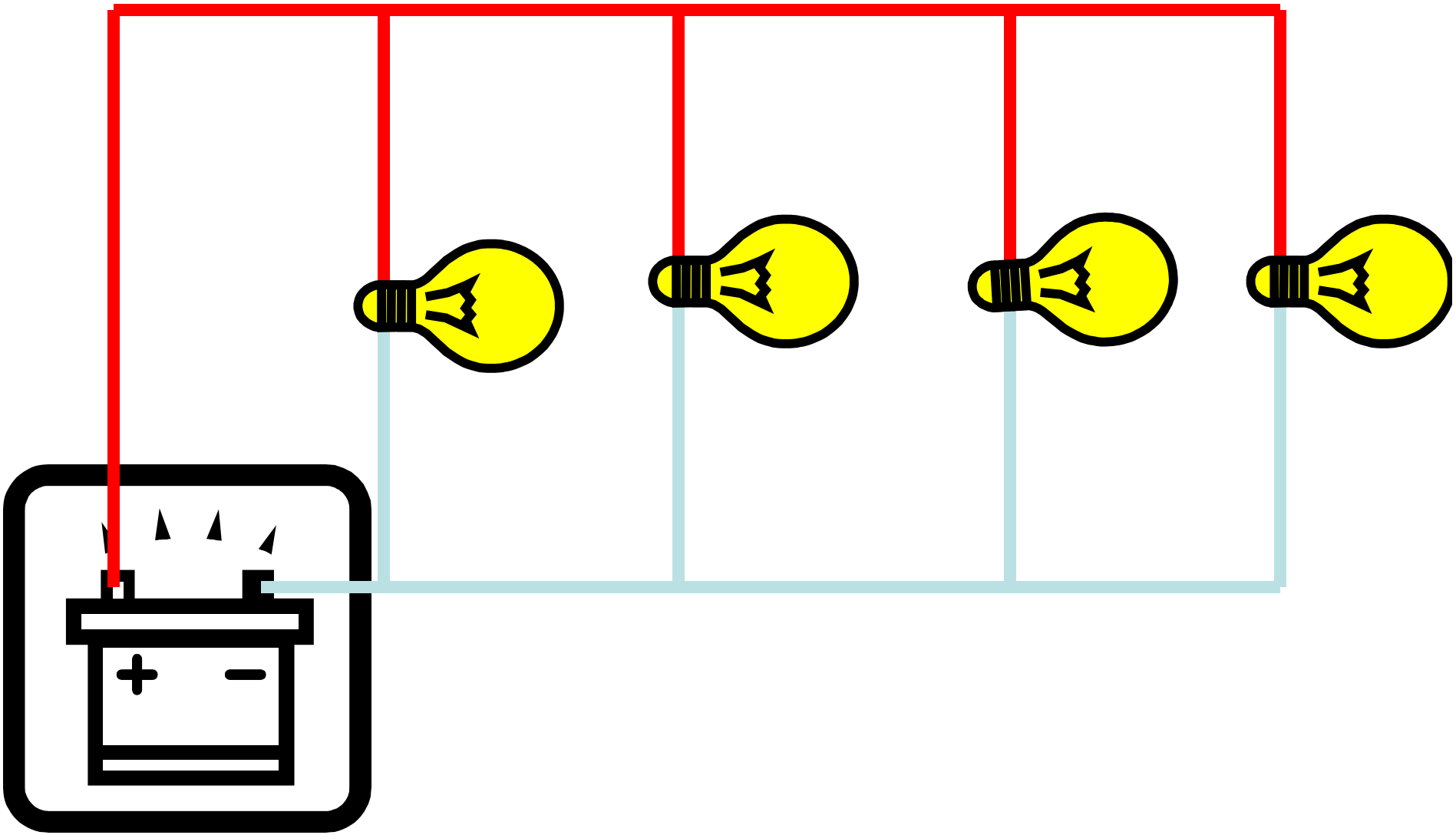
Series Circuit



There are 2 types of circuits:

- Parallel Circuit – there are several branching paths to the components. If the circuit is broken at any one branch, only the components on that branch will turn off.

Parallel Circuit



Ohm's Law

- Resistance = Voltage / Current

- Ohms = Volts / Amps

Practice with Ohm's Law

Ohms	Volts	Amps
	100	25
	150	10
	30	15
9		5
6	48	


Domain 3: Physics-
Magnetism

What is an electromagnet?

- Electromagnet – a magnet made from a current bearing coil of wire wrapped around an iron or steel core.

What is a generator?

- Generator – a machine that changes mechanical energy to electrical energy
- Usually use moving magnets to create currents in coils of wire.

What is a motor?

- Motor – a device that changes electrical energy to mechanical energy that can do work.